CHAPTER 1
INTRODUCTION

The Javelin surface-attack guided missile and launcher is a fire-and-forget, man-portable, medium antiarmor weapon consisting of a command launch unit (CLU) and a round. Its top-attack and direct-attack modes and its 2,000-meter range enable the Javelin to defeat current and projected enemy armor threats. The Javelin is operated by an individual soldier or in crews of two or three. Soldiers can use the Javelin during the day, at night, and during limited visibility conditions.

1-1. WEAPON SYSTEM

The Javelin weapon system consists of a Javelin, a basic skills trainer (BST), a field tactical trainer (FTT), and a missile simulation round (MSR).

a. **Javelin**. The Javelin is a fire-and-forget, shoulder fired, man-portable medium antiarmor weapon that consists of a reusable M98A1 CLU and a round. The CLU houses the daysight, night vision sight (NVS), controls, and indicators. The round consists of the missile and the launch tube assembly (LTA) (Figure 1-1), and the battery coolant unit (BCU). The missile contains the guidance section, mid-body section, warhead section, propulsion section and control actuator section. The LTA serves as the launch platform and carrying container for the missile.

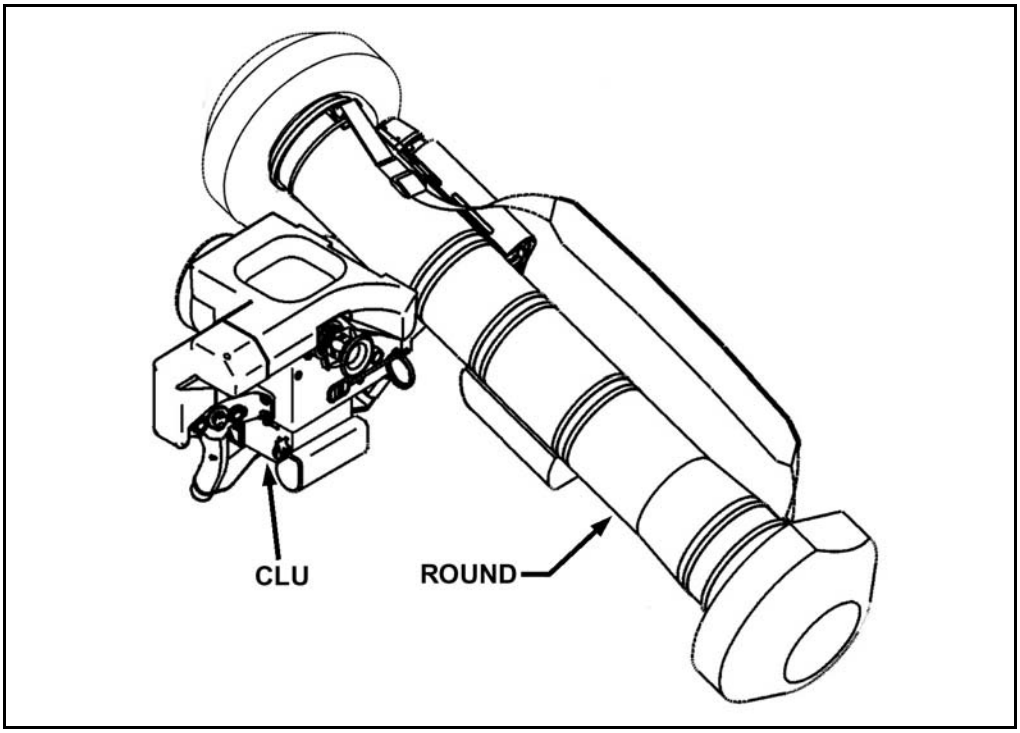

Figure 1-1. Javelin.

b. **Basic Skills Trainer**. The BST is an indoor training device that consists of a student station (SS) and an instructor station (IS) (Figure 1-2, page 1-2). The student

station consists of a simulated command launch unit (SCLU) and an MSR. The IS has a desktop computer, a monitor, a keyboard, a mouse, an interconnect cable, and a surge suppressor. The BST training exercises use real terrain models and actual visible and infrared imagery, and matching three-dimensional target models for natural target movements. The gunner sees a realistic simulated battlefield environment.

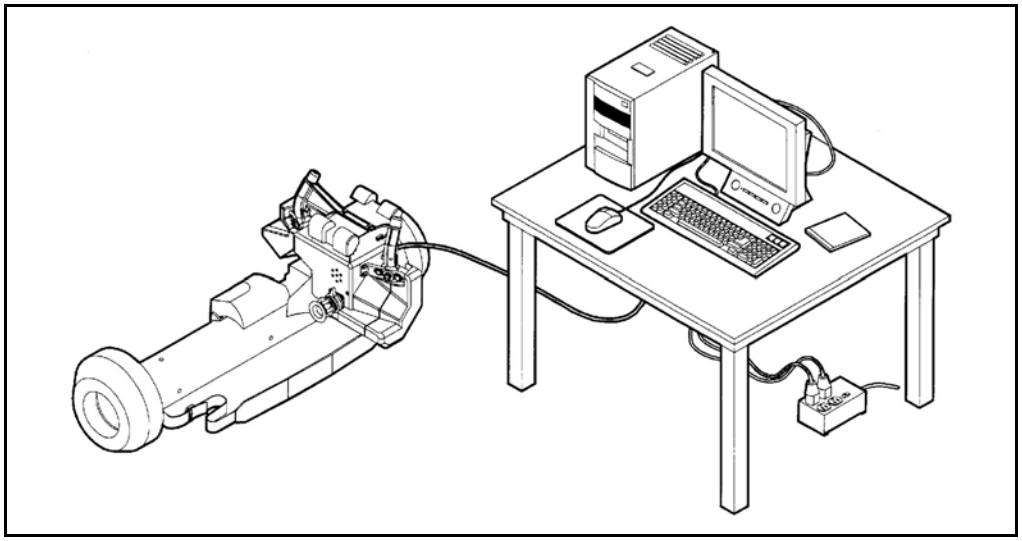

Figure 1-2. Basic skills trainer.

c. **Field Tactical Trainer**. The FTT is an outdoors, force-on-force, trainer used in conjunction with a tactical CLU and a simulated round (SR). The FTT consist of an IS, which is used to monitor the student (Figure 1-3). The SR is equipped with multiple-integrated laser engagement system (MILES).

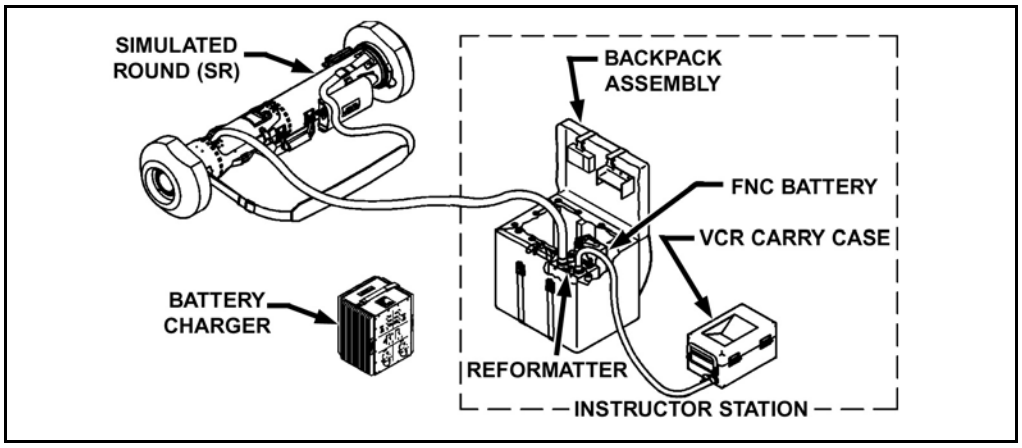

Figure 1-3. Field tactical trainer.

d. **Missile Simulation Round**. The MSR is a field handling round with a simulated launch tube (Figure 1-4). It replicates the weight and balance of the actual round. The FTT contains no instruments or circuitry and is used to train gunners on how to maintain, handle, and carry the round.

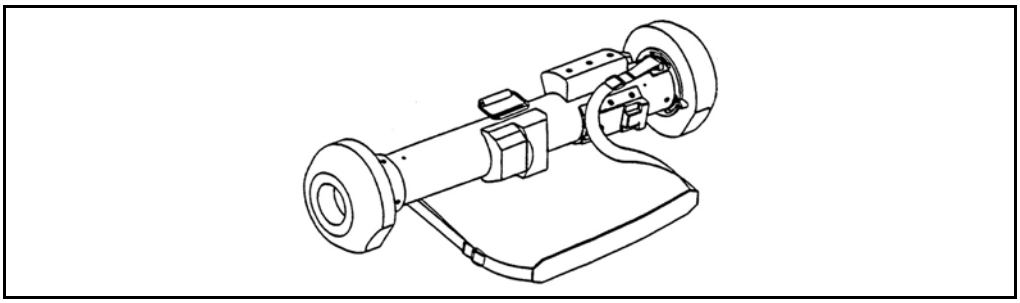

Figure 1-4. Missile simulation round.

1-2. EQUIPMENT DESCRIPTION AND DATA

Tables 1-1 through 1-3 show the Javelin's capabilities and features, the physical characteristics of the CLU, and the physical characteristics of the round.

Javelin Missile System	**Surface Attack Guided Missile and M98A1 Command Launch Unit**	
Type of System	Fire and Forget	
Crew	one- to three-soldier teams based on TO&E	
Missile modes	**Top Attack (default)** **Direct Attack**	
Ranges	**Top Attack Mode minimum effective engagement**	150 meters
	Maximum effective engagement range (Direct Attack and Top Attack modes)	2,000 meters
	Direct Attack Mode minimum effective engagement range	65 meters
Flight Time	About 14 seconds at 2,000 meters	
Backblast Area (See Figure 1-11 and Appendix A for safety factors.)	*Primary danger zone* extends out 25 meters at a 60-degree (cone shaped) angle.	
	Caution zone extends the cone-shaped area out to 100 meters	
Propulsion–Two Stage Motor	*Launch motor* ejects the missile from the LTA	
	Flight motor propels the missile to the target	
Firing From Inside Enclosures	Minimum room length	15 feet
	Minimum room width	12 feet
	Minimum room height	7 feet

Table 1-1. Javelin capabilities and features.

M98A1 Command Launch Unit (CLU)	*With battery, carrying bag, and cleaning kit*	
	Weight	14.16 lb. (6.42 kg)
	Length	13.71 in (34.82 cm)
	Height	13.34 in (33.88 cm)
	Width	19.65 in (49.91 cm)
	Carry bag only	
	Weight	0.60 lb. (0.27 kg)
Sights	*Daysight*	
	Magnification	4X
	Field-of-view (FOV)	4.80° x 6.40°
	Night Vision Sight	
	Wide field-of-view (WFOV) magnification	4.2X
	WFOV	4.58° x 6.11°
	Narrow field-of-view (NFOV) magnification	9.2X
	NFOV	2.00° x 3.00° (approximately)
Battery Type	*Lithium Sulfur Dioxide* ($LiSO_2$) BA-5590/U (Nonrechargeable)	
	Number required	1
	NSN	6135-01-036-3495
	Weight	2.2 lbs. (1.00 kg)
	Life	4.0 hrs below 120°F (49°C)
		3.0 hrs between 50°F to 120°F (10°C to 49°C)
		1.0 hrs between -20°F to 50°F (-49°C to 10°C)
		0.5 hrs above 120°F (49°C)

Table 1-2. Physical characteristics of the command launch unit.

Complete Round (Launch tube assembly with missile and BCU)	*Weight and dimensions*	
	Weight	35.14 lb. (15.97 kg)
	Length	47.60 in (120.90 cm)
	Diameter with end caps	11.75 in (29.85 cm)
	Inside diameter	5.52 in (14.00 cm)
Battery Coolant Unit	*Weight*	2.91 lb. (1.32 kg)
	Dimensions	
	Length	8.16 in (20.73 cm)
	Width	4.63 in (11.75 cm)
	Battery	
	Type	Lithium, nonrechargeable
	Life	4 min of BCU time
	Coolant gas	Argon

Table 1-3. Physical characteristics of the round.

Figure 1-5 shows the Javelin backblast danger area. The primary danger area is a 60-degree sector, with the apex of the sector at the aft end of the missile launch motor. For more safety information, see Appendix A.

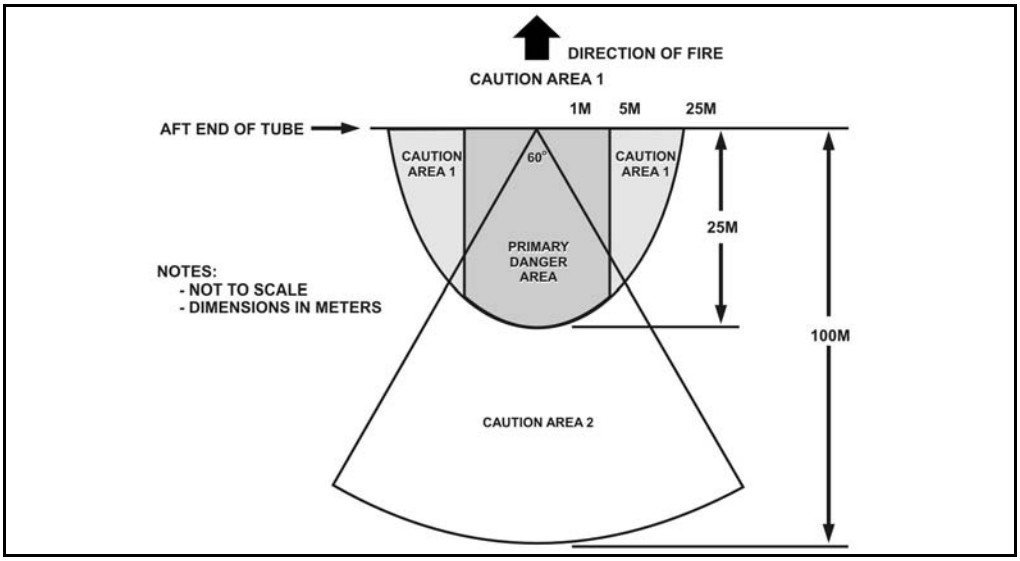

Figure 1-5. Javelin backblast safety zones.

1-3. COMMAND LAUNCH UNIT

The M98A1 CLU is the reusable portion of the Javelin system (Figure 1-6). And contains a daysight, night vision sight, controls, and indicators. The CLU components are a main housing, absorbers, handgrips, battery compartment, daysight, night vision sight, eyepiece, test connector, and round interface connector. The command launch unit attaches to the LTA.

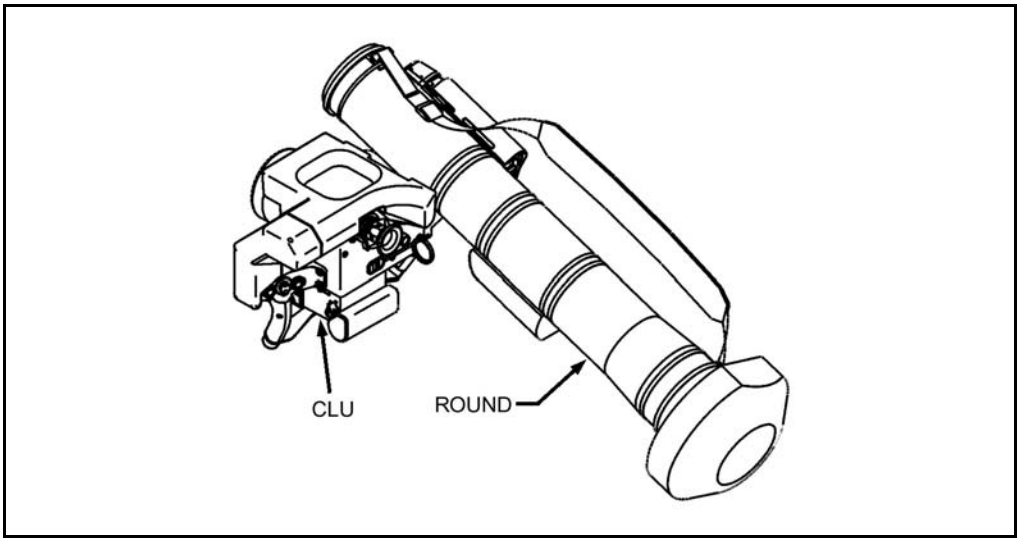

Figure 1-6. Javelin components.

a. **Main Housing**. The main housing (body) of the CLU (Figure 1-7) contains the system's electronics, the display, daysight, and night vision sight.

b. **Absorbers**. The absorbers (Figure1-7) around the main housing of the CLU help protect the equipment during operation. The absorbers are replaceable. One absorber is a face shield that protects the gunner's face during missile launch.

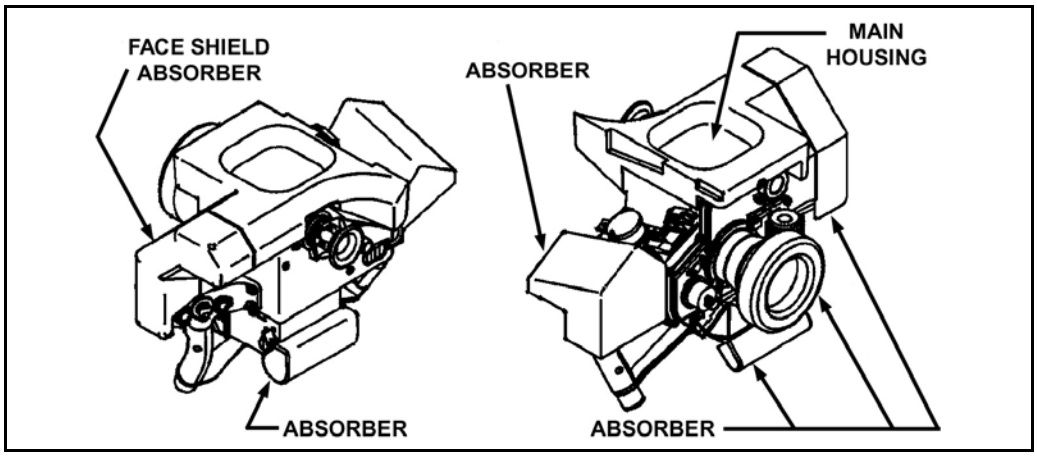

Figure 1-7. Main housing and absorbers.

c. **Handgrips**. The gunner uses the handgrips attached to the sides of the main housing (Figure 1-8) to hold the CLU. The gunner uses the controls on the handgrips for all Javelin operations.

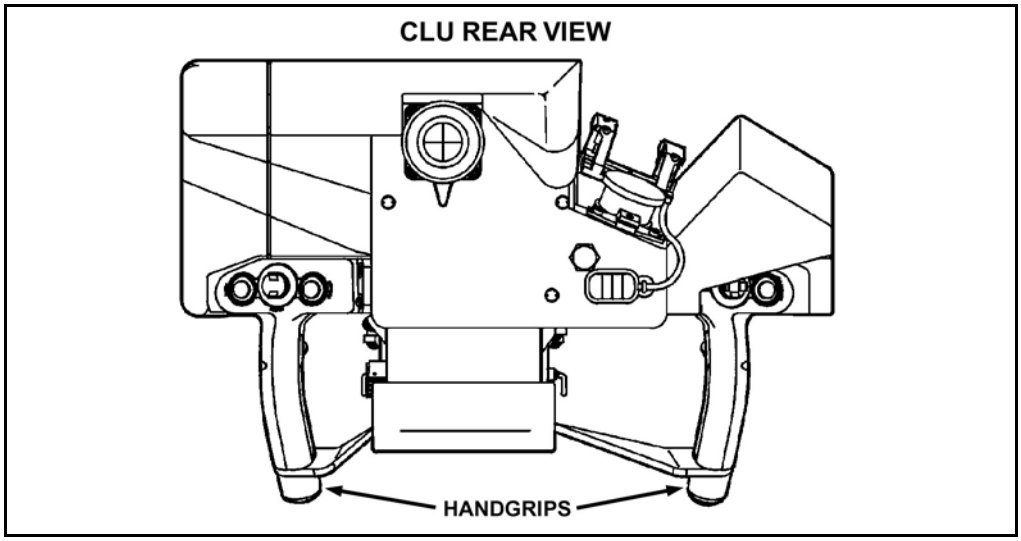

Figure 1-8. Handgrips.

d. **Battery Compartment**. Located on the bottom of the main housing, the battery compartment (Figure 1-9) houses the nonrechargeable BA-5590/U or the rechargeable BB390A battery (*for training use only*). The same battery is used in the single-channel

ground and airborne radio system (SINCGARS) and can be interchanged with the CLU. A connector on the battery compartment joins to a corresponding connector on the battery. A wire bail holds the detachable battery compartment cover in place.

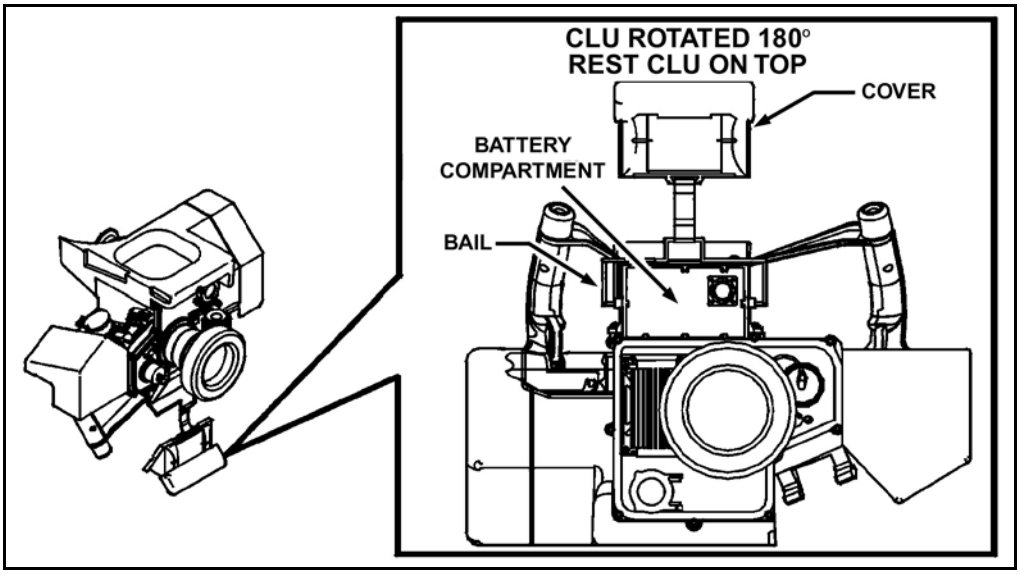

Figure 1-9. Battery compartment.

e. **Daysight**. The daysight works much like a telescope and consists of a lens, status indicators, and an eyepiece (Figure 1-10). The daysight.

(1) Provides the gunner a visible-light image with 4X magnification for target viewing and battlefield surveillance.

(2) Can be used with power off for surveillance only to save battery life.

(3) Is not affected by infrared clutter.

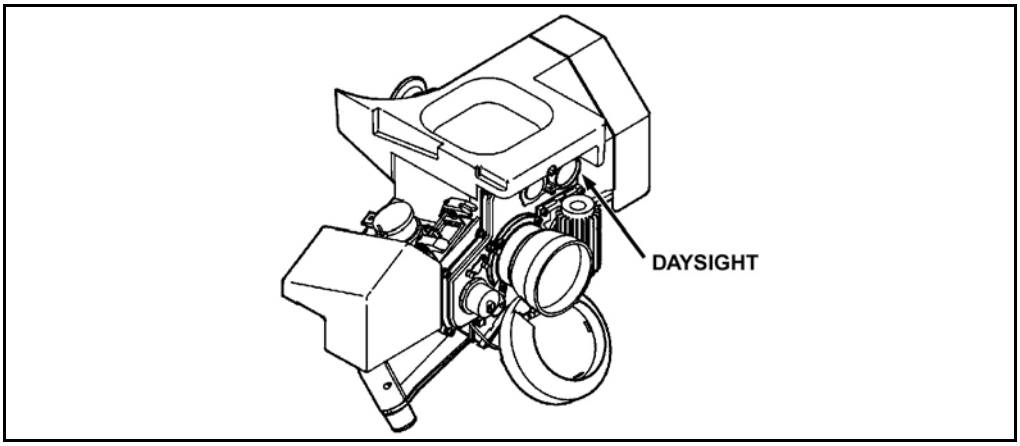

Figure 1-10. Daysight.

f. **Night Vision Sight**. The NVS is the primary sight used by the gunners (Figure 1-11, page 1-8). The NVS is an imaging infrared (I2R) system, used during day

or night. It allows the gunner to see during conditions of limited visibility including darkness, obscuration, smoke, fog, inclement weather, and IR clutter. The NVS operates by converting an infrared target image to a visible-light image for the gunner. The NVS consists of the NVS lens, detector Dewar cooler, CLU display and eyepiece provides the gunner with both a 4X (WFOV) and 9X (NFOV) magnification for scanning and target detection.

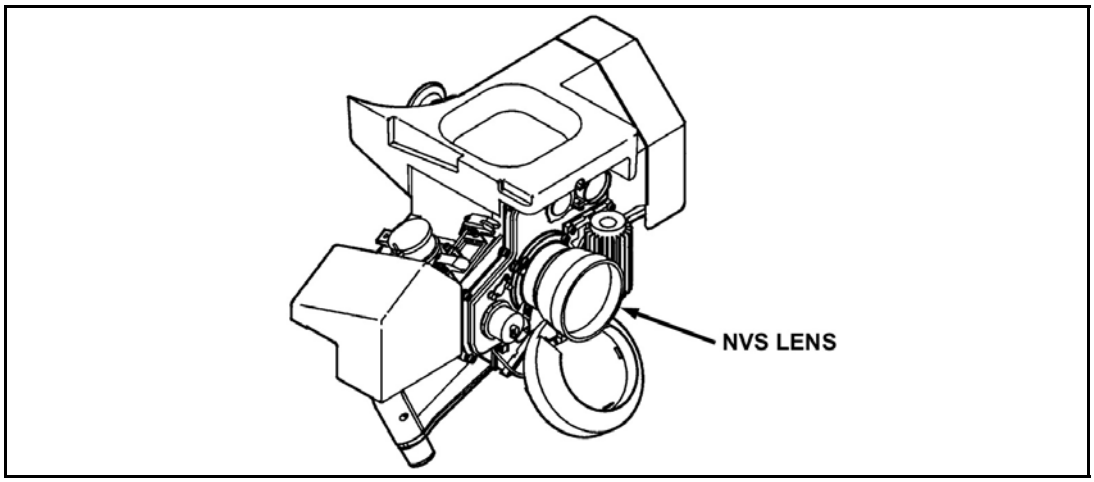

Figure 1-11. Night vision sight lens.

(1) Detector Dewar cooler (DDC) (Figure 1-12) cools the NVS to the proper operating temperature and converts infrared energy to electrical signals. These signals are sent to the CLU display by way of the signal processor to provide the gunner a picture of the target area.

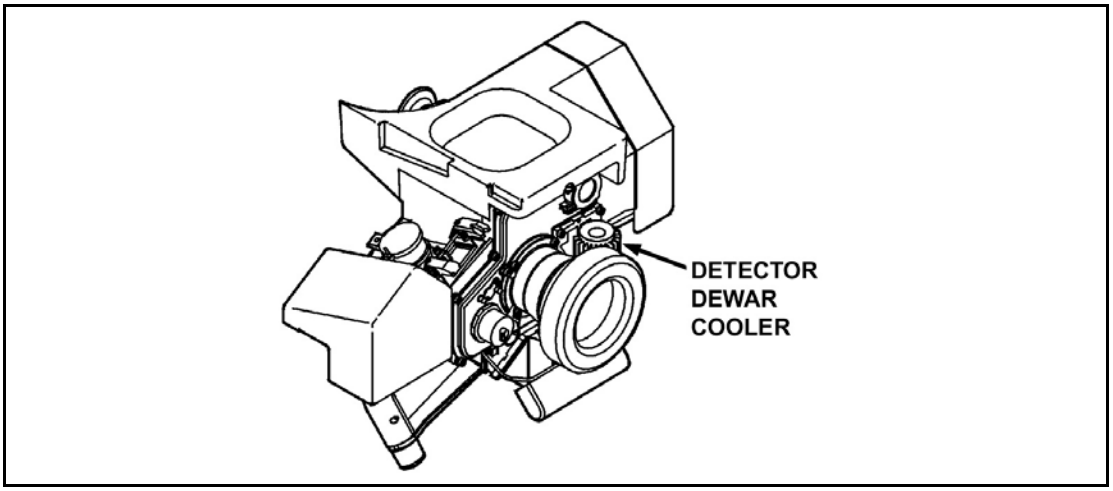

Figure 1-12. Detector Dewar cooler.

(2) The CLU display is like a miniature television, which is used to make the wide field of view (WFOV), narrow field of view (NFOV), and seeker infrared images visible to the gunner. The cathode ray tube (CRT) converts electrical signals from the signal processor into visible images for the gunner.

(3) The CLU status indicators (Figure 1-13) are fourteen icons that surround the CLU display. The icons identify operational modes, conditions, and malfunctions coded in green, amber, and red. The icons give the gunner continuous feedback about the current missile readiness or possible system malfunctions, visible during day and night usage. All indicators will be explained in detailed in Chapter 2.

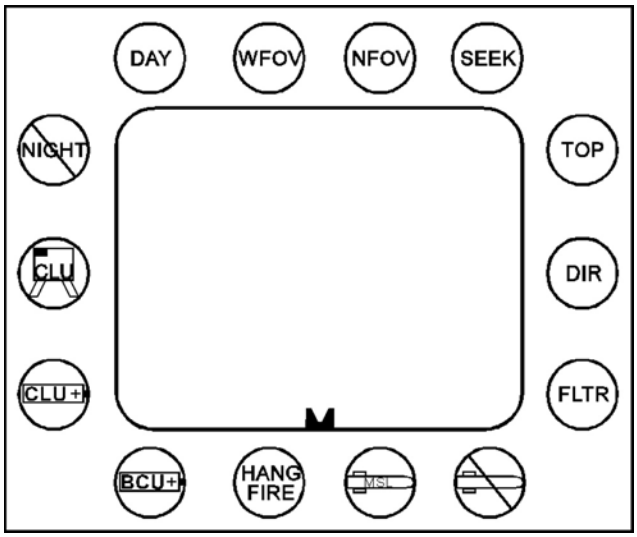

Figure 1-13. Status indicators.

(4) The eyepiece (Figure 1-14) allows the gunner to see the CLU display. Through the eyepiece, the gunner sees the DAY FOV, WFOV, NFOV, seeker FOV, and the status indicators. The eyepiece consists of a lens assembly, eyecup, and diopter adjust ring.

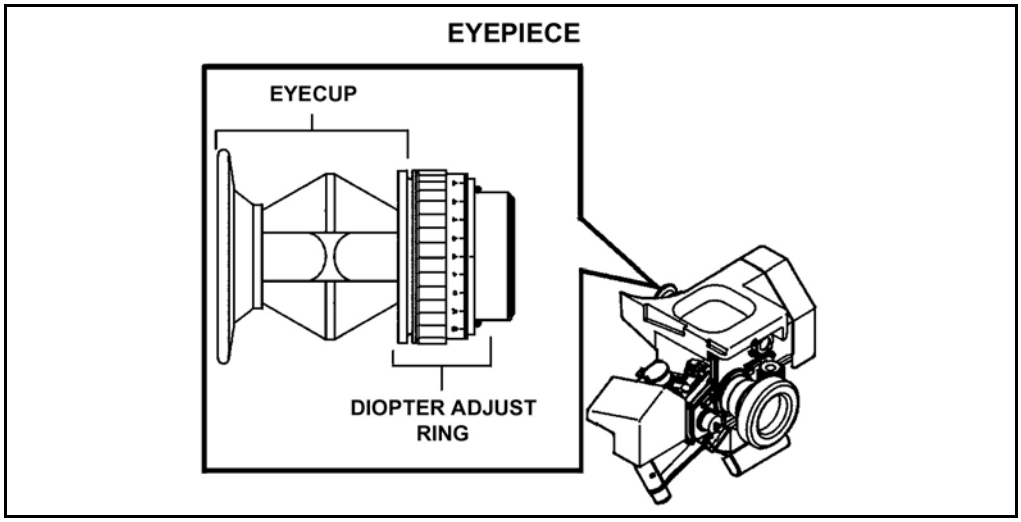

Figure 1-14. Eyepiece.

(5) The test connector (Figure 1-15) is used to perform direct support (DS) or higher-level maintenance and to interface with the FTT.

(6) The round interface connector (Figure 1-15) provides the electrical connection between the CLU and the round.

(7) The humidity indicator (Figure 1-15) displays the quality of the air inside the CLU (white or blue within acceptable levels; pink requires maintenance).

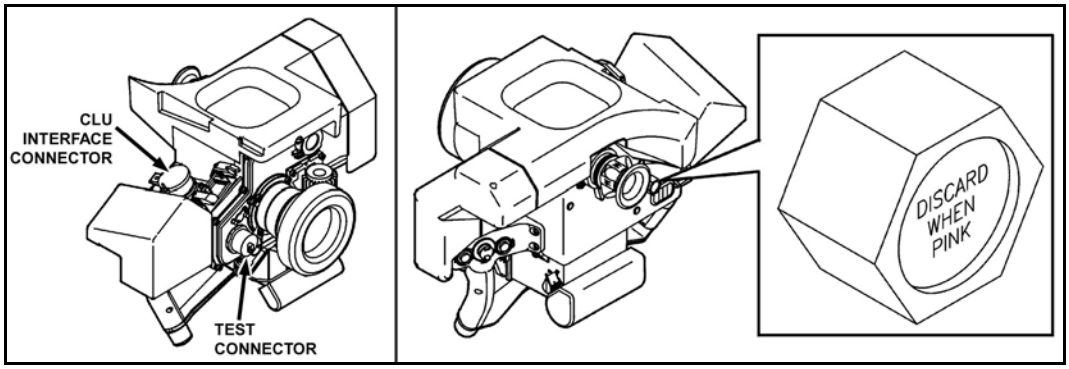

Figure 1-15. Test connector, round interface connector, and humidity indicator.

1-4. ROUND

The round consists of the LTA, the BCU, and the missile (Figure 1-16, page 1-11). The LTA interfaces with the CLU and serves both as a handling container and launch platform for the missile. The LTA consists of a launch tube, forward and aft end caps,

carry handle, shoulder strap, CLU interface connector, and shoulder pad. The round has a 10-year shelf life. The only requirement for maintenance is for stockpile surveillance.

a. **Launch Tube**. The launch tube houses the missile. It is a single-piece, composite graphite/epoxy design. The launch tube protects the missile from the environment before the missile is launched. All other LTA components mount externally on the tube. Once the missile is launched, the LTA is discarded.

b. **End Caps**. Two end caps (forward and aft) protect the missile from damage during transport and handling.

(1) The forward end cap protects the seeker dome from moisture, dust, and other elements that could harm it. The forward end cap is removed when preparing for launch. The pressure release valve is used to reduce the pressure in the LTA so the forward end cap can be removed. If the missile is not fired, replace the forward end cap (Figure 1-16) to protect the seeker dome.

(2) The aft end cap (Figure 1-16) is permanently attached to the LTA. The center of the cap is blown out by the launch motor blast during launch.

c. **Carry Handle**. The carry handle (Figure 1-16) is used to lift and carry the round.

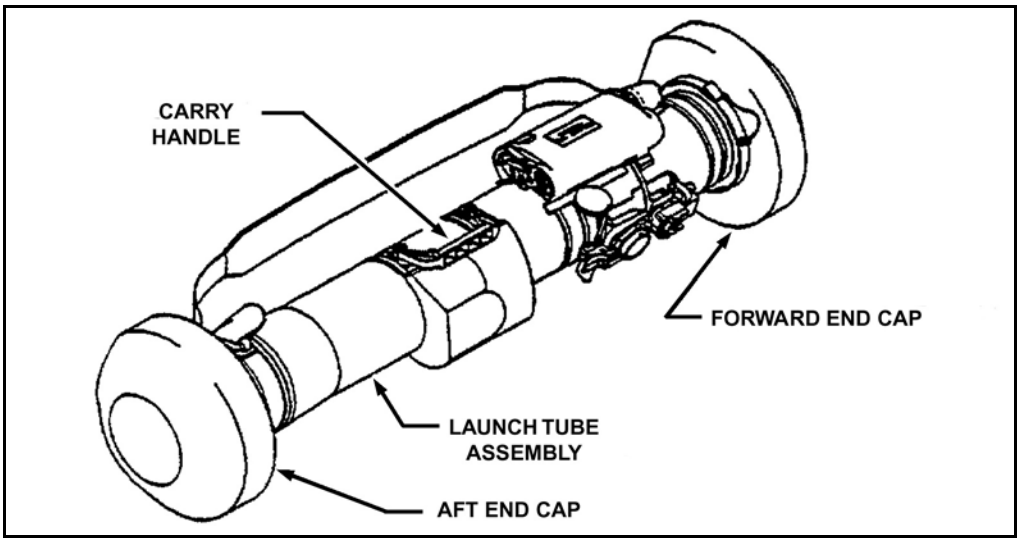

Figure 1-16. LTA, end caps, and carry handle.

e. **Shoulder Strap**. The adjustable shoulder strap (Figure 1-17, page 1-12) provides a means for carrying the round.

f. **Shoulder Pad**. The shoulder pad (Figure 1-17) provides balance and support when the round is placed on the gunner's shoulder.

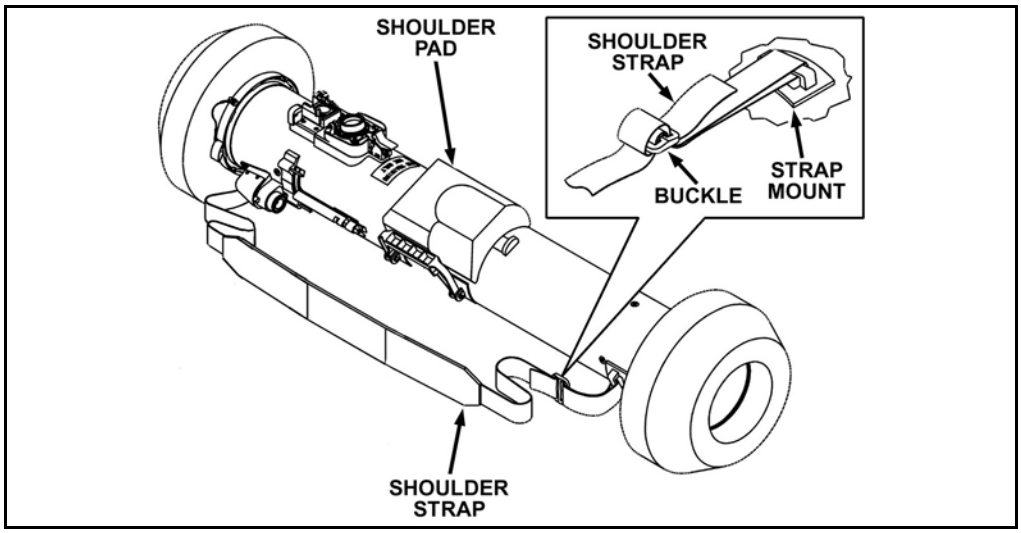

Figure 1-17. Shoulder strap and pad.

f. **Command Launch Unit Interface Connector**. The CLU interface connector (Figure 1-18) provides the electrical interface between the round and CLU. Signals are passed through the connector between the CLU and round, which includes: digital information, power, and seeker image signals.

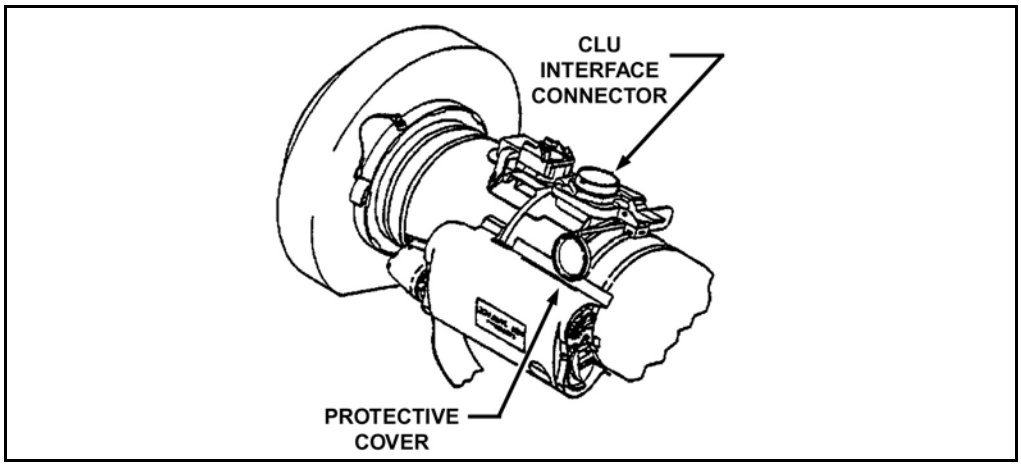

Figure 1-18. CLU interface connector.

g. **Battery Coolant Unit.** The BCU (Figure 1-19) has the battery section and a compressed-gas coolant section. The battery section powers the missile electronics before missile launch. The coolant section cools the missile seeker to its operating temperature before missile launch. The BCU is a single-use unit with 4 minutes of operating time and is not rechargeable. Once the missile has been fired, the spent BCU is discarded with the LTA.

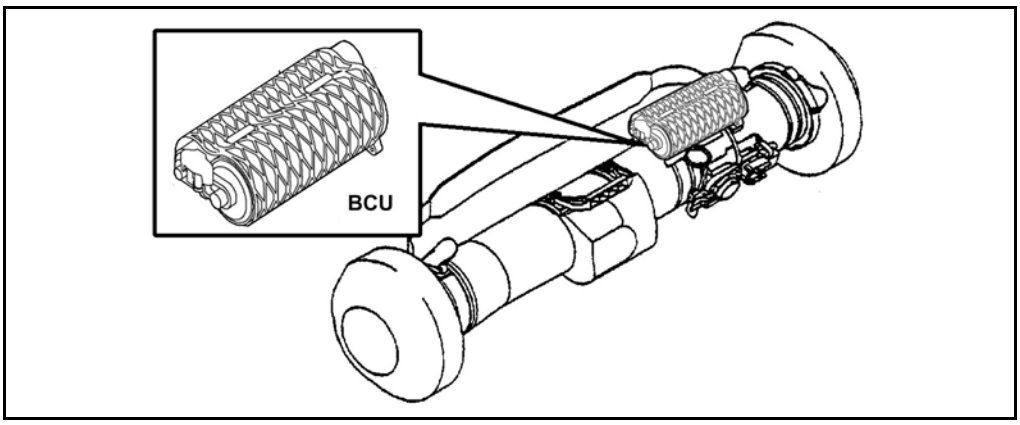

Figure 1-19. Battery coolant unit.

h. **Missile.** The Javelin missile is environmentally sealed in the LTA (Figure 1-20).

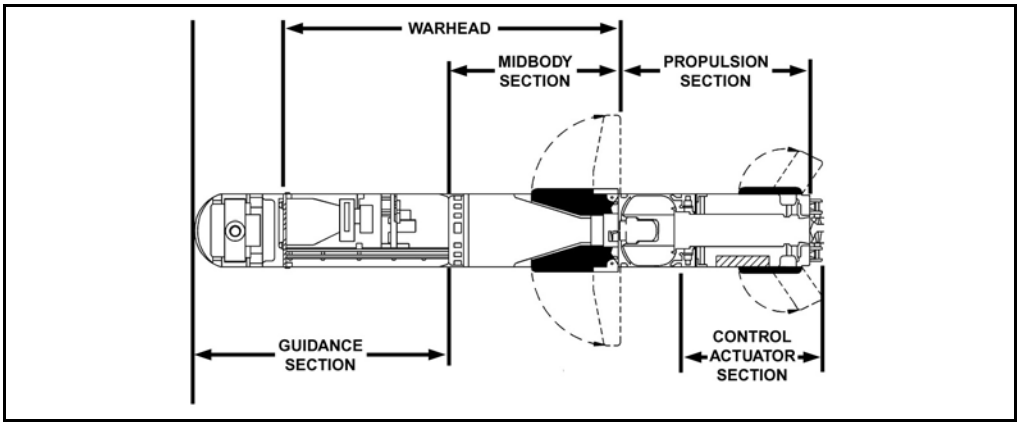

Figure 1-20. Javelin missile.

1-5. MISSILE OPERATION

The missile consists of the guidance section, the mid-body section, the warhead, the propulsion section, and the control actuator section (Figure 1-21, page 1-14).

a. **Guidance Section.** The guidance section (Figure 1-21, page 1-14) provides target tracking and flight control signals. It is the forward section of the missile and includes the seeker head section and the guidance electronics unit.

(1) ***Seeker Head***. The seeker head section, known as the seeker, contains the missile imaging infrared (I^2R) system and the contact switches to detonate the warhead. The missile I^2R system gives the missile its fire-and-forget capability. During flight to the target, the missile I^2R system tracks the target and sends target location information to the on board guidance electronics unit.

(2) ***Guidance Electronics Unit***. The guidance electronics unit (GEU) serves two functions. It controls the seeker head so it *looks* at the target and sends signals to the control actuator section to guide the missile to the target during flight.

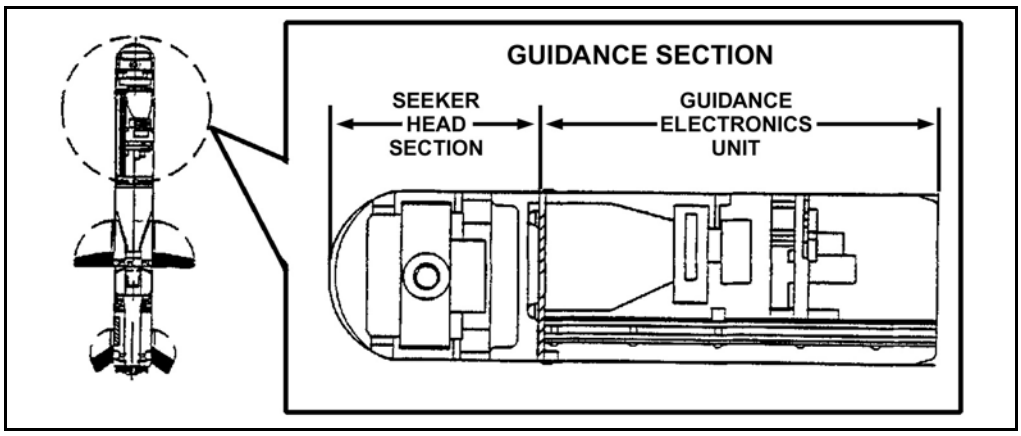

Figure 1-21. Missile guidance section.

b. **Mid-Body Section**. The mid-body section includes the missile skin, electronic safe arm and fire unit (ESAF), wings, and the main charge of the warhead (Figure 1-22).

(1) ***Missile Skin***. The missile skin is a structural part of the missile and provides environmental protection for the internal components during flight.

(2) ***Electronic Safe, Arm, and Fire***. The ESAF is the principal safety device that prevents accidental ignition of the motors and accidental warhead detonation. The ESAF consists of circuits and two detonators (one for the precursor and one for the main charge). The ESAF controls missile launch sequence and warhead detonation. It permits starting the rocket motors in the proper sequence when the gunner pulls the fire trigger and all other firing conditions have been met. When the missile hits the target, the ESAF detonates each warhead charge in sequence.

(3) ***Wings***. The wings provide lift and keep the missile stabilized during flight. The wings fold into slots in the missile skin when the missile is in the LTA and deploy into flight position after clearing the LTA.

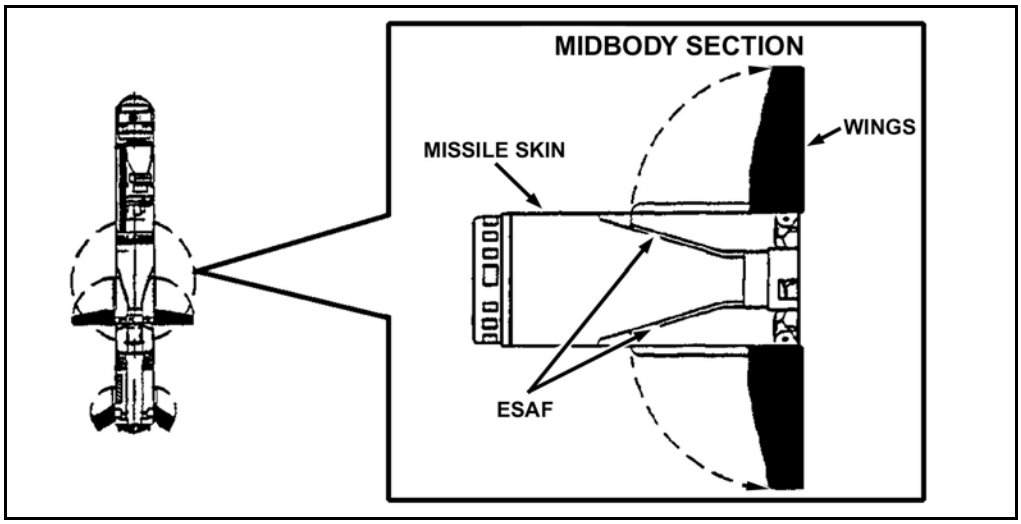

Figure 1-22. Mid-body section.

c. **Warhead Section**. The Javelin missile uses a dual charged warhead (Figure 1-23). The warhead has a precursor charge and main charge.

(1) The precursor charge is a HE antitank shaped charge. Its purpose is to cause reactive armor on the target to detonate before the main charge reaches the armor. Once the reactive armor is penetrated, the target's main hull is exposed to the warhead's main charge. If the target is not equipped with reactive armor, the precursor provides additional explosives to penetrate the main armor.

(2) The main charge is the second charge of a dual-charge warhead and is also an HE antitank shaped charge. The primary warhead charge is designed to penetrate the target's main armor to achieve a target kill.

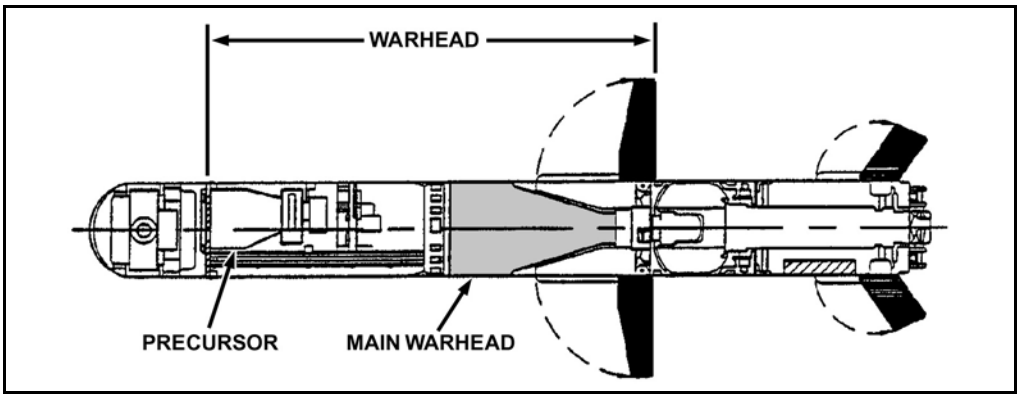

Figure 1-23. Missile warhead.

d. **Propulsion Section**. The propulsion section (Figure 1-24, page 1-16) consists of the launch and flight motors.

(1) ***Launch Motor***. The launch motor propels the missile out of the LTA. It provides the initial force to push the missile a safe distance from the gunner before the flight motor ignites to ensure the gunner's safety. The launch motor is completely spent by the time the missile clears the LTA, this accounts for the low signature after launch.

(2) ***Flight Motor***. The flight motor powers the missile to the target during flight. It ignites when the missile is a safe distance from the gunner, protecting the gunner from hot exhaust gases generated when the motor fires.

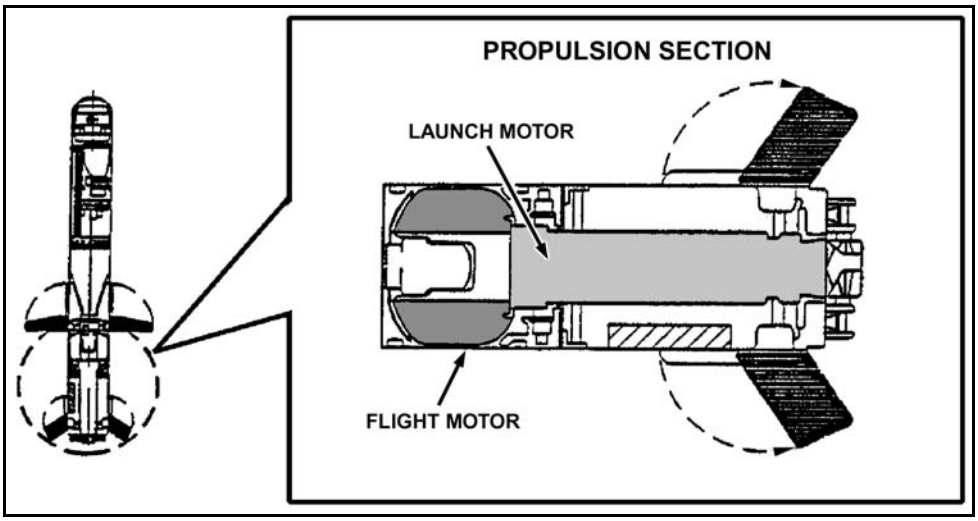

Figure 1-24. Missile propulsion section.

e. **Control Actuator Section**. The control actuator section (Figure 1-25) maneuvers the missile during flight and provides internal electrical power. The control actuator section consists of four control fins, four thrust vector control vanes, and a thermal battery.

(1) ***Control Fins***. The control fins maneuver the missile during flight. The fins are spring-loaded, automatically deploy, and lock into flight position after the missile clears the LTA. During flight, they adjust automatically to guide the missile to the target.

(2) ***Thrust Vector Control***. The thrust vector control (TVC) vanes aid the control fins in maneuvering the missile during flight by deflecting the flight motor exhaust. This control changes the angle of thrust from the flight motor, resulting in a change to the missile's flight path.

(3) ***Thermal Battery***. The thermal battery provides internal electrical power for the missile during flight. It is sealed in the body of the missile.

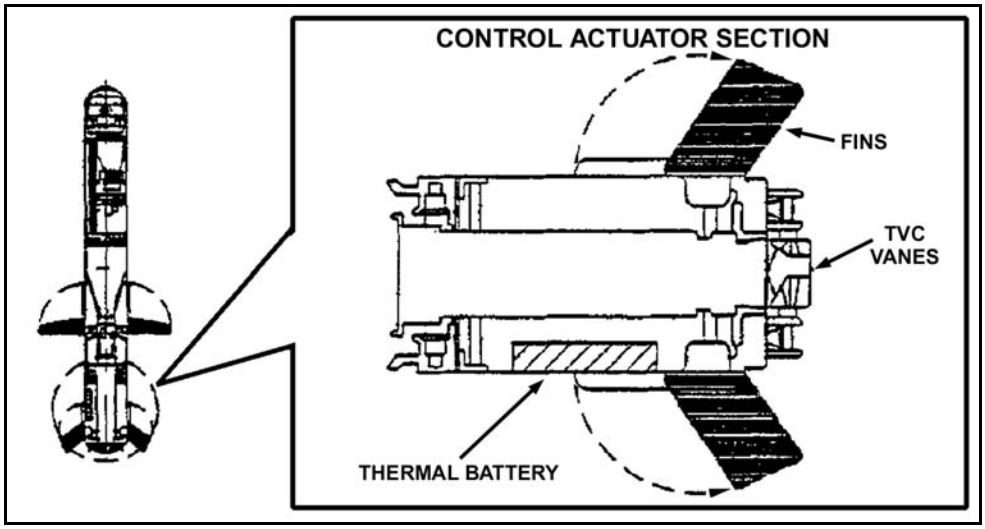

Figure 1-25. Control actuator section.

1-6. CAPABILITIES AND FEATURES

The missile has two gunner-selectable attack modes: top or direct. Each mode has its own flight path or *profile* for reaching the target.

a. **Top Attack Mode.**

(1) The top attack is the default mode when the missile seeker is first activated. In the top attack mode, the missile approaches from above to impact and detonate on the top of the target (Figure 1-26). This capacity allows the gunner to attack a vehicle from the front, rear, or the side and greatly increases the probability of a kill. Armored vehicles usually have less protective armor on top. The minimum engagement distance is 150 meters.

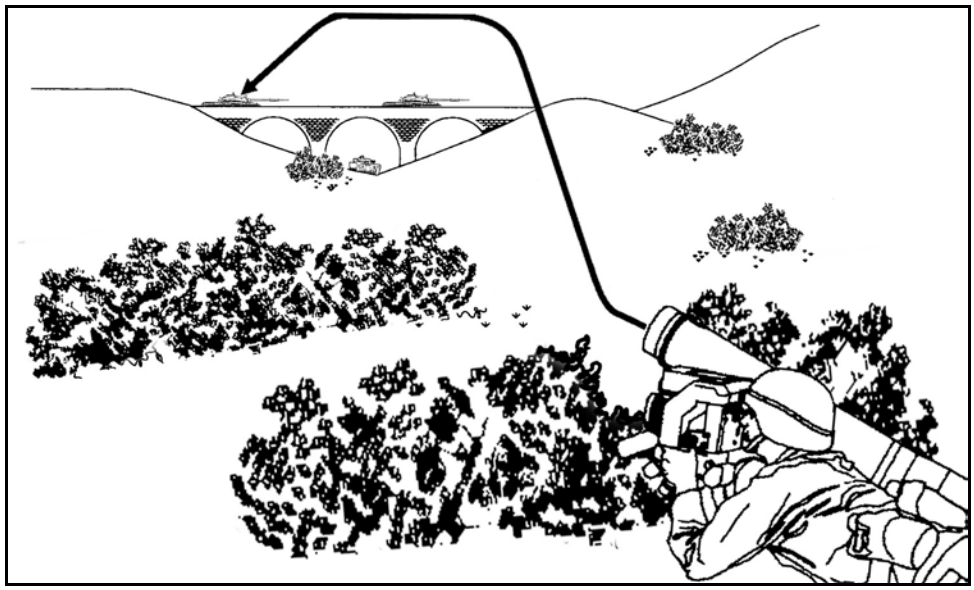

Figure 1-26. Top attack mode.

(2) The exact profile of the missile flight path depends on the range to the target and is determined automatically by the missile's onboard software). When firing at a 2,000-meter target, the missile reaches a height of about 160 meters above the battlefield (Figure 1-27). If the target is under a protective structure, using the top attack mode will cause the missile to detonate on the structure instead of on the target. The gunner can select the direct-attack mode to counter targets hiding under protective cover.

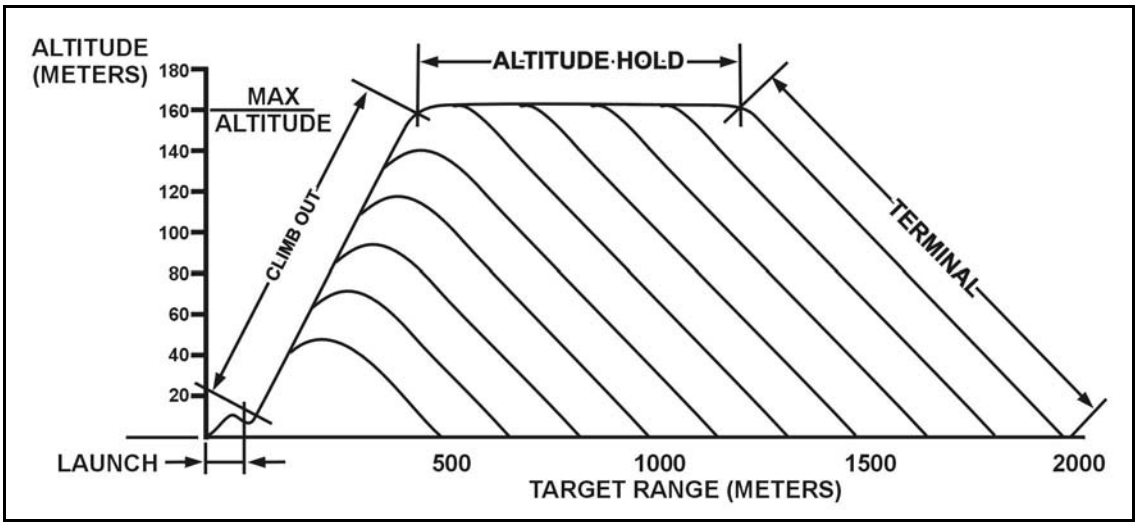

Figure 1-27. Top attack flight path.

b. **Direct Attack Mode.**

(1) The direct attack mode can be selected only after seeker cooldown and before lock-on. The gunner pushes the attack select (ATTK SEL) switch on the right handgrip to change attack modes. In the direct attack mode, the missile flies on a more direct path to the target. The missile impacts and detonates on the side (front, rear, or flank) of the target Figure 1-28). The minimum engagement distance is 65 meters.

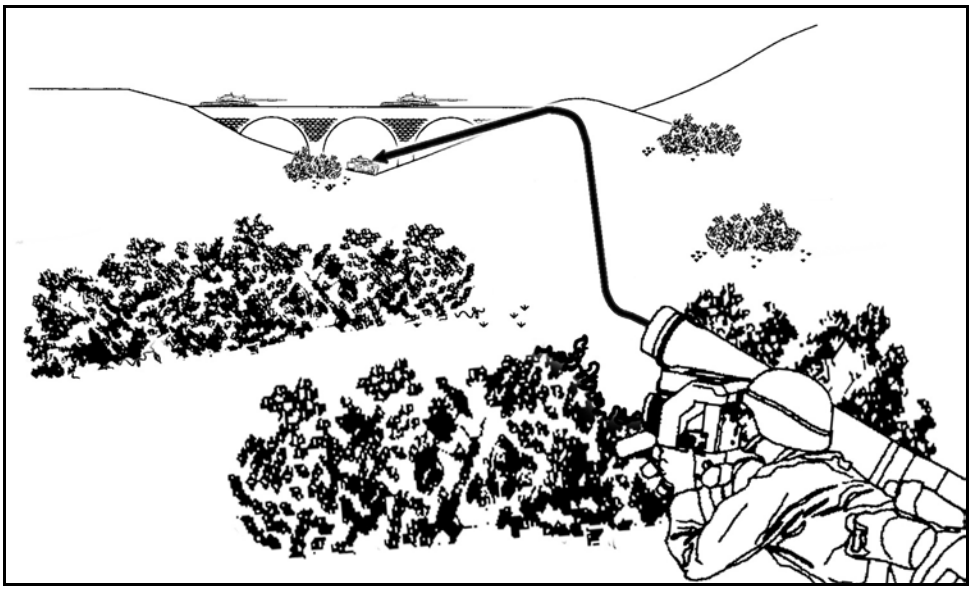

Figure 1-28. Direct attack mode.

(2) The exact profile of the missile flight path shown in a general configuration in Figure 1-29 depends on the range to the target and is determined automatically by the missile's onboard software. With a 2,000-meter target, the missile reaches a height of

about 60 meters above the battlefield. This path allows the missile to reach a target under a protective structure.

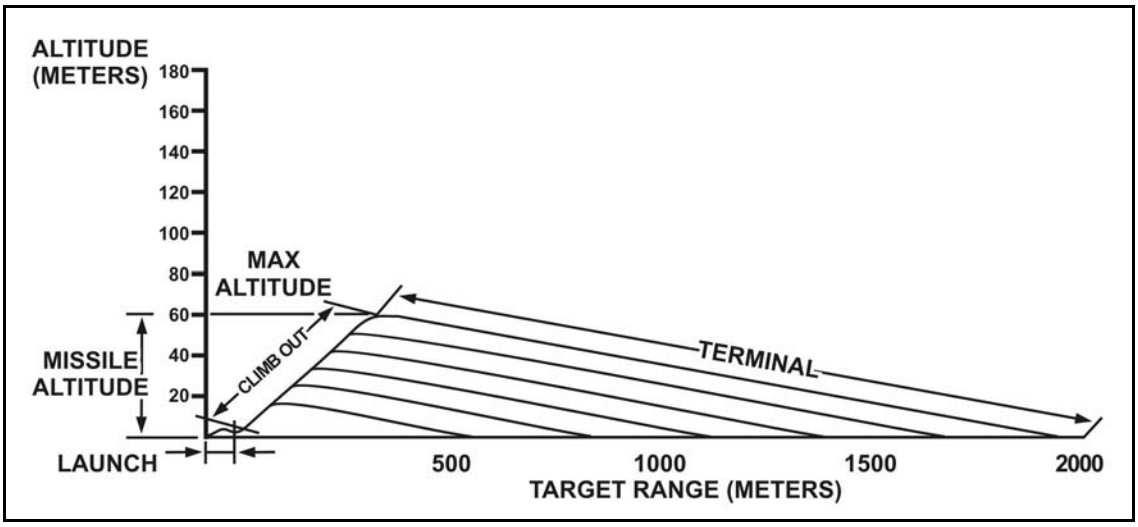

Figure 1-29. Direct attack flight path.